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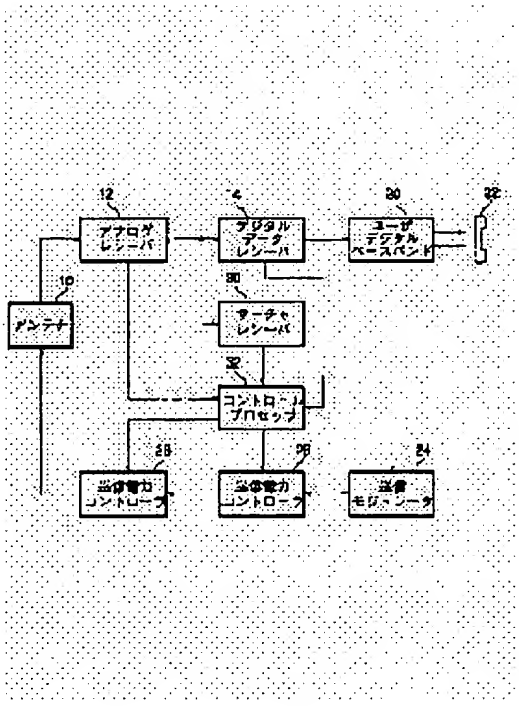
(54) TRANSMISSION POWER CONTROLLER IN MOBILE COMMUNICATION AND ITS SYSTEM

(57)Abstract:

PURPOSE: To increase the capacity of the system by implementing accurate transmission power control at a mobile set side.

CONSTITUTION: A control processor 32 detects received power and the reception power is calculated from a strength of a pilot signal fed from a searcher receiver 30 in this case. Thus, the signal strength of a transmission signal from a base station from which a mobile set is communicated is accurately detected. Furthermore, a fading speed is estimated from a change in the received power thereby controlling an averaging time in a transmission power controller 28. Thus, the system copes even with a change in the fading speed and the optimum averaging time is always obtained. Then an electric field median strength is always detected without causing a response delay and accurate transmission power control is attained.



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* NOTICES *

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CLAIMS

[Claim(s)]
[Claim 1] The transmitted power control unit in the mobile communications characterized by having the searcher receiver which detects the signal level of the extracted pilot signal, and the transmitted power control means which control transmitted power according to the signal level from this searcher receiver while extracting the pilot signal for every base station out of an input signal.
[Claim 2] The transmitted power control unit in mobile communications characterized by providing the following A level detection means to detect the signal level of an input signal An equalization means to carry out average processing of the signal level of the detected input signal in predetermined equalization time, and to obtain average input-signal level Transmitted power control means which control transmitted power according to the obtained average signal level A phasing speed-detection means to detect phasing speed from change of the signal level of an input signal, and an equalization time-control means to change the above-mentioned equalization time according to the obtained phasing speed
[Claim 3] The transmitted power control unit in mobile communications characterized by providing the following A level detection means to detect the signal level of an input signal A history storage means to memorize the history of the signal level of the obtained input signal A prediction means to predict the signal level of the input signal after a predetermined time from the history memorized A creation means to create the power control command about the transmitted power control in a signal transmitting side according to the signal level predicted, and a transmitting means to transmit the created power control command
[Claim 4] It is a transmitted power control unit in the mobile communications characterized by predicting by the linear prediction from the content of the history the above-mentioned prediction means is remembered to be in equipment according to claim 3.
[Claim 5] It is a transmitted power control unit in the mobile communications characterized by detecting based on the number of times to which the above-mentioned phasing speed-detection means investigates the change state of input-signal level in equipment according to claim 2, and input-signal level intersects constant value in a predetermined time.
[Claim 6] The transmitted power control unit in mobile communications characterized by providing the following The searcher receiver which detects the signal level of the extracted pilot signal while extracting a pilot signal out of an input signal An equalization means to carry out average processing of the signal level from this searcher receiver in predetermined equalization time, and to obtain average signal level Transmitted power control means which control transmitted power according to the obtained average signal level A phasing speed-detection means to detect phasing speed from change of the signal level from a searcher receiver, and an equalization time-control means to change the above-mentioned equalization time according to the obtained phasing speed
[Claim 7] The transmitted power control system which controls the transmitted power by the side of the mobile in the mobile communications between the base stations and mobiles which are characterized by providing the following A base station side is a signal level detection means to detect the input-signal

level of the electric wave sent from a mobile. A history storage means to memorize the history of the signal level of the obtained input signal, and a prediction means to predict the signal level of the input signal after a predetermined time from the history memorized, A creation means to create the power control command about the transmitted power control in a signal transmitting side according to the signal level predicted, It has a transmitting means to transmit the created power control command. a mobile side With the searcher receiver which detects the signal level of the extracted pilot signal while extracting a pilot signal out of an input signal An equalization means to carry out average processing of the signal level from this searcher receiver in predetermined equalization time, and to obtain average signal level, and transmitted power control means which change the determined transmitted power according to a power transmitting command while determining transmitted power according to average signal level

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[Translation done.]

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] this invention relates to the transmitted power control in the mobile communications by the CDMA (code division multiple access) method.
[0002]
[Description of the Prior Art] Mobile communications, such as a car telephone and a cellular phone, are spreading widely with progress of electronic communication technology in recent years. And also in the field of these mobile communications, digital communications are examined and various kinds of communication modes are examined. There is a CDMA (code division multiple access) method as one of such the methods, and since it has the features, like that two or more mobiles can be assigned to the same frequency range and a nondisclosure is easy, attention is attracted.
[0003] A diffusion means by which a PN code etc. performs a spread spectrum other than the transmitter which performs the usual electric wave communication, a receiver, and a modem is required, and the back-diffusion-of-gas means for carrying out back-diffusion of gas of the PN code is required of this CDMA method (especially direct diffuse-spectrum diffusion : CDMA method using DS/SS).
[0004] And it is necessary to take out the signal by which the spread spectrum is carried out and to get over by the specific sign by the CDMA method, out of two or more diffusion signals in the same frequency band. In a CDMA system, by transmission (forward link) to a mobile from a base station, the pseudo-random sign which has a different phase shift for every base station is made into the diffusion sign, and each channel is multiplexed by the orthogonal function (a cross-correlation is the function of 0), and is transmitted so that a mobile can discriminate a base station. The pilot signal is also contained in it and a mobile uses this pilot signal for initial prehension and a synchronization.
[0005] Moreover, in transmission (reverse link) to a base station from a mobile, what formed successively a pseudo-random sign without offset and the pseudo-random signs specified for every user is made into the diffusion sign. Since each mobile has a various distance with a base station, it is difficult to take the synchronization of the sending signals of all mobiles in a base station, and it is impossible to maintain the orthogonality between each mobile. Since a diffusion sign also took such a point into consideration and it was determined, if the position which only overlap only shifted, a mutual interference is small enough. However, when a big difference is in received power from the mobile not only in such interference but a base station, interference with the big power of the mobile which was big received power for the mobile which was small received power will be given. Also in such a situation, it has the transmitted power control means for making it the intensity of the received power from each mobile become fixed.
[0006] Here, there are the same thing and a thing which is different in a mobile [resulting from Rayleigh phasing etc.] and base station side in change of the received power in mobile communications by the mobile [, such as a loss (shadowing) accompanying radio-shielding objects, such as a building which exists in the loss (path loss) based on distance and propagation path of a radio-wave-propagation path,], and base station side.

[0007] About what produces the same on-the-strength change in a mobile and base station side, the received radio field intensity in a base station is brought close to constant value by measuring the received-power intensity of the transmitted electric wave from a base station in a mobile, averaging this in time of the grade which can remove the influence of Rayleigh phasing, detecting an equalization median, and controlling transmitted radio field intensity based on this (this is called open loop control). Specifically, it is the AGC circuit (in order to avoid the input of the excessive signal to the latter part) of the IF signal (intermediate frequency signal which carried out the down conversion of the received radio frequency signal (RF signal)) in the input stage of a receiver. Received power is detected from the signal about the gain of the circuit which controls the gain of amplifier according to input signal intensity, and the signal strength of the signal frequency band after band pass filter (filter which passes only desired frequency band) passage, and transmitted power is controlled according to this.
[0008] In order that received power may increase rapidly like [when a mobile slips out of the shadow of a building] on the other hand and big influence may appear in other communications in this case, you have to decrease transmitted power promptly. Then, the equalization time for calculating an above-mentioned median from increase of received power is set up short that it should be coped with in such a case. That is, to reduction (increase of received power) of transmitted power, it is short in equalization time, equalization time is set up for a long time to increase (reduction in received power) of transmitted power, and transmitted power control of an open loop is performed.
[0009] On the other hand, about that from which field strength differs by the mobile [, such as Rayleigh phasing,] and base station side, it cannot respond by open loop control. Then, in order to cope with this, in a base station, the received field strength from each mobile station is detected, and the command (power control command) of an amendment sake is sent for transmitted power to a mobile station side at a mobile station based on this received field strength. And the mobile is considering as the thing of a request of the received field strength in a base station by controlling transmitted power based on this power control command (this is called closed loop control). Power control command orders it whether to raise power or to lower, and is transmitted once to 1.25msec. Moreover, control of about **1dB is performed around open loop power control by one control.
[0010] By performing such transmitted power control, these interference can be decreased considering the intensity of the input signal from each mobile in a base station as an equivalent thing. Then, communication with more mobiles is attained and the capacity of a system can be maximized.
[0011] In addition, the transceiver facility and the conventional transmitted power control by the side of the mobile of a CDMA method and a base station (salesite) are shown, for example in U.S. JP,5,103,459,B, the international public presentation official report WO 91/No. 07037 official report, etc.
[0012]
[Problem(s) to be Solved by the Invention] However, if it was in the conventional transmitted power control, there were the following troubles.
(A) The sending signal from other base stations is also contained in received power, and the sending-signal intensity from other base stations is large especially in the boundary neighborhood of the jurisdiction range of a base station (cell). Then, the transmitted power control to the target base station will become unsuitable. In addition, theoretically, since the electric energy changed by 1 time of the command by power control command as mentioned above although this must be cancelable with closed loop control is limited, it may exceed an amendment limitation.
[0013] (B) Since Rayleigh phasing changes with speed of a mobile, depending on the speed of phasing, a mean time is too short and transmitted power control of an open loop may follow Rayleigh phasing. When a mean time is lengthened too much, it becomes impossible in addition, to follow change of a phasing median.
[0014] (C) Although power control command is inserted into the usual communication data in a forward link and it is sent once to 1.25msec(s) on the average, the insertion point (timing to send) is randomized. Moreover, in the reverse link, in the silent period, a mobile does not transmit continuously, and performs bursty transmission and this transmit timing is also randomized. For example, in the frame of 20msec,

although 16 slots of 1.25msec units exist, in the case of a full rate, all 16 slots are transmitted, and, in the case of 1/2 rate, it transmits a slot to eight of 16 places. And the phase of the slot is randomized. In addition, there are a full rate, 1/2 rate, 1/4 rate, and 1/8 rate as transmission rate. For this reason, a base station recognizes the received power from a mobile, and time until power control command is received by the mobile is changed. Then, it is not fixed, the timing of control shifts and the time when transmitted power control according to power control command is performed may be unable to perform exact transmitted power control. Especially, this problem becomes large when phasing speed is early.
[0015] this invention is made in view of the above-mentioned technical problem, and aims at offering the transmitted power control unit in the mobile communications which are adapted for the situation of a mobile and can perform suitable transmitted power control, and its system.
[0016]
[Means for Solving the Problem] The transmitted power control unit in the mobile communications concerning this invention is characterized by having the searcher receiver which detects the signal level of the extracted pilot signal, and the transmitted power control means which control transmitted power according to the signal level from this searcher receiver while it extracts the pilot signal for every base station out of an input signal.
[0017] Moreover, a level detection means to detect the signal level of an input signal and an equalization means to carry out average processing of the signal level of the detected input signal in predetermined equalization time, and to obtain average input-signal level, The transmitted power control means which control transmitted power according to the obtained average signal level, It is characterized by having a phasing speed-detection means to detect phasing speed from change of the signal level of an input signal, and an equalization time-control means to change the above-mentioned equalization time according to the obtained phasing speed.
[0018] Moreover, it is characterized by to have a level detection means detect the signal level of an input signal, a history storage means memorize the history of the signal level of the obtained input signal, a prediction means predict the signal level of the input signal after a predetermined time from the history memorized, a creation means create the power control command about the transmitted power control in a signal transmitting side according to the signal level predicted, and a transmitting means transmit the created power control command.
[0019] Moreover, the above-mentioned prediction means is characterized by predicting by the linear prediction from the content of the history memorized.
[0020] Moreover, the above-mentioned phasing speed-detection means investigates the change state of input-signal level, and is characterized by detecting based on the number of times to which input-signal level intersects constant value in a predetermined time.
[0021] With moreover, the searcher receiver which detects the signal level of the extracted pilot signal while extracting a pilot signal out of an input signal An equalization means to carry out average processing of the signal level from this searcher receiver in predetermined equalization time, and to obtain average signal level, The transmitted power control means which control transmitted power according to the obtained average signal level, It is characterized by having a phasing speed-detection means to detect phasing speed from change of the signal level from a searcher receiver, and an equalization time-control means to change the above-mentioned equalization time according to the obtained phasing speed.
[0022] this invention is a transmitted power control system which controls the transmitted power by the side of the mobile in the mobile communications between a base station and a mobile. moreover, a base station side A signal level detection means to detect the input-signal level of the electric wave sent from a mobile, A history storage means to memorize the history of the signal level of the obtained input signal, and a prediction means to predict the signal level of the input signal after a predetermined time from the history memorized, A creation means to create the power control command about the transmitted power control in a signal transmitting side according to the signal level predicted, It has a transmitting means to transmit the created power control command. a mobile side With the searcher receiver which detects the signal level of the extracted pilot signal while extracting a pilot signal out of

an input signal While determining transmitted power as an equalization means to carry out average processing of the signal level from this searcher receiver in predetermined equalization time, and to obtain average signal level, according to average signal level It is characterized by having the transmitted power control means which change the determined transmitted power according to a power transmitting command.
[0023]
[Function] Thus, according to this invention, since received power is detected using a pilot signal, to the input-signal power of only the base station of a local station, transmitted power can be controlled and suitable power control can be performed. Moreover, phasing speed is presumed, since it decides on time for input-signal power to average according to this phasing speed, it can average in always suitable time and the electric-field median of phasing can be presumed. For this reason, an open loop is appropriately controllable, and transmitted power can be increased, without causing increase of interference of a system. Moreover, degradation of the transmission characteristic of a local station can be prevented, without increasing interference of a system.
[0024] Furthermore, in a base station side, since the situation of the future of the electric wave from the mobile which receives in a base station is predicted and power control command is transmitted, let control of the received power by the side of a base station be an exact thing by controlling transmitted power according to this power control command. And such a result, transmitted power control becomes exact and the improvement in a transmission characteristic and increase of circuit capacity are attained.
[0025]
[Example] Hereafter, the example of this invention is explained based on a drawing.
[0026] The block diagram 1 by the side of a mobile is a block diagram showing the whole move machine composition to which the transmission-control equipment concerning this invention is applied. In drawing, an antenna 10 receives the electric wave containing the frequency used for communication at least. The analog receiver 12 is connected to this antenna 10, and while the analog receiver 12 changes a received electric wave into an intermediate frequency (down conversion) and obtaining an IF signal, only a band chooses the signal of predetermined frequency. Moreover, it controls by the AGC means to become fixed about the signal level of the IF signal to output. The digital data receiver 14 is connected to the analog receiver 12, and the digital data receiver 14 processes conversion to the digital data of an analog signal, a synchronous detection, spectrum back-diffusion of gas, etc. The user digital baseband circuit 20 is connected to the digital data receiver 14, and the user digital baseband circuit 20 performs a data recovery etc., and obtains an audio signal through the interface of a sound signal etc. And this audio signal is supplied to a hand set 22, and reproduction of an audio signal is performed. That is, the voice which received from the loudspeaker of a hand set 22 is outputted.
[0027] On the other hand, as for the hand set 22, the microphone is also formed, and a sound signal is supplied to the user digital baseband circuit 20 as an audio signal. In the user digital baseband circuit 20, the interface of voice coding etc. is connected to through and the transmitting modulator 24, and processing of A/D conversion, modulations (for example, QPSK modulation etc.), a spread spectrum (for example, direct diffusion by the PN code), etc. is performed here. And the series connection of the transmitted power controllers 26 and 28 is carried out to the transmitting modulator 24, amplification processing of here predetermined gain is performed to it, and it is transmitted to it from an antenna 10 (usually, after a rise conversion is carried out, transmitted).
[0028] The searcher receiver 30 is connected to use and the analog receiver 12 of a pilot signal, the pilot signal contained in an input signal here is extracted, and this signal strength is detected. Although it is a signal for using for initial prehension of the base station in a mobile station etc. and the same sign is used in each base station, since this pilot signal has given the sign of a different shift amount, it becomes discriminable based on this. Moreover, this pilot signal is multiplexed by communication data etc. by the Walsh function, and W0 (Walsh function of No.0) is usually assigned. Then, with the Hadamard filter, a pilot signal can be extracted and this signal level can be known. Measurement of pilot level here is performed using path diversity. This is technology which separates frequency-selective phasing which often originates in multiplex transmission delay with the resolution of a diffusion sign, performs bigger

weighting to a thing with the separated large level, and doubles and compounds time in mobile communications. By using this path die HASHICHI, measurement of pilot level with a high precision can be performed. And the searcher receiver 30 compares the signal level of the pilot signal from two or more base stations, and generates the signal for change of a base station etc.
[0029] In this example, the control processor 32 is connected to the searcher receiver 30, and the signal about the level of a pilot signal is supplied here. Moreover, the signal about the gain of AGC from the analog receiver 12 and the signal about the power control command from the digital data receiver 14 are also supplied to this control processor 32.
[0030] And the control processor 32 knows the AGC gain from the analog receiver 12, and the level of the pilot signal which received from both level of the pilot signal from the searcher receiver 30. And the control processor 32 generates the level control signal of an analog from the obtained receiving intensity, and controls the power of the output signal in the transmitted power controller 28 by this. Moreover, the control processor 32 knows the content about the transmitted power control sent from a base station side from the power control command supplied by the digital data receiver 14, and controls the transmitted power controller 26 according to this. Thus, the control processor 32 can perform transmitted power control of an open loop and a closed loop.
[0031] The member for transmitted power control is shown in the block diagram 2 for transmitted power control. Thus, the analog receiver 12 consists of down converter 12a, band pass filter 12b, IF-amplifier12c, and AGC detector 12d. Then, RF signal supplied from an antenna 10 is changed into an IF signal with DAUNKO barter, and the signal of the frequency band used for communication by band pass filter 12b is chosen. The output of band pass filter 12b is made the IF signal of the level of simultaneously regularity by IF-amplifier 12c, and is supplied to the digital data receiver's 14 A/D converter. Moreover, in order to control the output level of an IF amplifier, AGC detector 12d is prepared, and this AGC detector 12d detects the output level of IF-amplifier 12c, and is carrying out feedback control of the gain of IF-amplifier 12c according to this.
[0032] And the signal about the gain to feed back is supplied to the control processor 32 this AGC detector 12d. Then, the control processor 32 can recognize the level of the pilot signal supplied by the searcher receiver 30, and the level of the pilot signal which received from both signals about AGC gain. Especially, the level of this pilot signal is separated and recognized for every base station in the searcher receiver 30 as mentioned above. Then, the received power obtained here can except the signal from other base stations, and can know correctly the received power of the signal from the base station which is communicating. Therefore, even if it is near the boundary of a cell (area the base station whose number is one has jurisdiction [area]) where the level of the signal of since it is two or more base stations becomes large, exact detection of the input-signal level from the target base station can be performed, and suitable transmitted power control can be performed by supplying the signal of a difference with desirable mobile station level to a transmitted power controller with this detection result.

[0033] Although the control processor 32 controls the transmitted power controller 28 according to the obtained received power, this transmitted power controller 28 consists of IF-amplifier 28a and gain controller 28b which controls this gain. And based on the gain control signal supplied from the control processor 32, gain controller 28b controls the gain of IF-amplifier 28a.
[0034] Here, in this example, the control processor 32 also supplies a time constant control signal to gain controller 28b besides a gain control signal. And gain controller 28b has variable resistance R1 and R2, diodes D1 and D2, and Capacitor C, as shown in drawing 3 . Moreover, variable resistance R1, the series connection of diode D1, and variable resistance R2 and the series connection of diode D2 are connected in parallel, a gain control signal is inputted into variable-resistance R1R2, and diodes D1 and D2 are connected to Capacitor C and the gain control edge of IF amplifier 28. Then, in case the potential of a gain control signal increases, the potential of the signal which controls the gain of IF amplifier 28 by the time constant which becomes settled with the value of R1 and C rises, and in case the potential of a gain control signal decreases, the potential of the signal which controls the gain of IF amplifier 28 by the time constant which becomes settled with the value of R2 and C descends. For this reason, the

response of transmitted power to a gain control signal is made to a different thing by making the value of R1 and R2 into a different thing. Time constant R1C of the power increase direction is set up more greatly than time constant R2C of the power reduction direction. For example, it is set up with R1=10R2.

[0035] Furthermore, change of the resistance of variable resistance R1 and R2 is attained with the time constant control signal, with the above-mentioned relation maintained. Then, the earliness of the response to received power can be changed from the instructions' from the control processor 32. And the control processor 32 detects phasing speed from change of received power, changes the resistance of R1 and R2 according to this, changes the time constant in this circuit, and controls the response of the transmitted power controller 28 to a gain control signal by this example.

[0036] Operation of detection of phasing speed, then the phasing detection in the control processor 32 is explained based on drawing 4 .

[0037] First, while initializing the number-of-times counter of level intersection (reset), operation of the timer which specifies a count period is started (S1). And value xn about the received power inputted It inputs and judges whether they are the last value xn-1 < presetting level and xn >= presetting level (S3). That is, it judges whether there was any level intersection by judging whether it changed from the value of under the presetting level determined beforehand to the above value. And if it is YES, the increment (1 addition) of the value of the number-of-times counter of level intersection will be carried out (S4). On the other hand, this S4 is bypassed when it does not cross in S3. Next, when having not judged and (S5) run out [whether the timer was turned off and] (did you check the value of a timer and did 1 time of a count period pass?), it returns to S2 and the count of level intersection is repeated. In addition, receiving level xn What is necessary is to carry out the 1msec grade equalization of the pilot level, and just to set the period of a timer as 1 second.

[0038] Thus, in order that the number of times of the level intersection in a predetermined time may count, next, it is the maximum Doppler frequency fd. It asks (S6). It asks for this maximum Doppler frequency by intersection counted value xpi1/2 e-1/2 of level. This is because it is known that phasing speed corresponds to the maximum Doppler frequency in many cases, and there is an above-mentioned relation to the number of times of level intersection and the maximum Doppler frequency in phasing in the mobile it runs at the rate of [considerable] an automobile etc. In addition, this is shown, for example in an electronic-intelligence communication society, months [140] 1, Showa 61 issue "the foundation of mobile communications", etc.

[0039] And the called-for maximum Doppler frequency fd It decides on the equalization time T suitable for calculating the median of shell phasing. For example, T=N/fd What is necessary is for the formula to say just to determine. Here, N is a constant and is said for the 36th place to be suitable. Thus, when the equalization time T is found, according to this, this is outputted in quest of a time constant control signal from a table (S8).

[0040] That is, the value of the variable resistance R1 and R2 in drawing 3 is changed according to R1=traveler's check, and R2=T/10C, and a gain control signal is averaged with Time T in the time constant of this circuit. Since a mean time becomes long too much when the traverse speed of a mobile is slow, an upper limit is established (for example, 10 seconds). And the gain of IF-amplifier 28a is controlled by the gain control signal averaged by the circuit where it did in this way and the time constant was set up.

[0041] Thus, in this example, since it asks for phasing frequency (the maximum Doppler frequency) and the equalization time T is changed according to this, always let equalization time T be the optimal thing. then, the thing for which equalization time is too short and transmitted power control of an open loop follows phasing -- it can prevent -- moreover -- and when phasing speed is quick, equalization time can be shortened and it can consider as the early thing of a response of transmitted power control of an open loop In addition, although the maximum Doppler frequency was used as a phasing speed, if the phasing speed is detectable even if it is other phasing, according to this, equalization time is controllable by the above-mentioned example. Furthermore, although the control processor 32 detected received power from the level of a pilot signal, it can also detect received power with the level of the IF signal outputted

by not only this but the analog receiver.
[0042] The composition by the side of a base station, next the composition of the communication device by the side of a base station are explained based on drawing 5 . The analog receiver 42 is connected to the antenna 40, this received electric wave is supplied to the analog receiver 42, and an IF signal is outputted. The IF signal from the analog receiver 42 is supplied to the digital data receiver 44 of a mho BAIRU unit "N" (the mho BAIRU unit is prepared corresponding to the number of the mobiles which communicate, and N is a sign which specifies one in it). And the signal which received processing of the back-diffusion of gas outputted by the digital data receiver 44 is supplied to an exchanger through the user digital baseband circuit 46.
[0043] Moreover, the signal from an exchanger is supplied to the transmitting modulator 48 from the user digital baseband circuit 46, and receives processing of a modulation, a spread spectrum, etc. here. The sending signal outputted from the transmitting modulator 48 is multiplexed with the signal from other transmitting modulators in an adder 50, and in an adder 52, the pilot signal from the pilot-signal generator 54 is supplied to the after [a multiplex] antenna 40, and it is transmitted here. And closed loop power COP 56 is formed in the base station side, from the input-signal level about the mobile station supplied by the digital data receiver 44, the transmitted power which should be used in case the mobile station transmits is calculated, and power control command is created. And closed loop power COP 56 supplies this power control command to the transmitting modulator 48, and the transmitting modulator 48 inserts power control command into a sending signal.
[0044] Here, the digital data receiver's 44 composition is shown in drawing 6 . Thus, the Hadamard transform of the correlation signal outputted from A/D converter 62 into which the IF signal from the analog receiver 42 is inputted, the PN generator 64 which generates a predetermined PN code, the PN correlator 66 which performs correlation with the PN code supplied from this PN generator 64, and the PN correlator 66 is carried out, and it has become the Hadamard transform filter 68 which solves Walsh coding from the user decoder 70 which performs the recovery of data. And the IF signal supplied by the analog receiver 42 is changed into digital data by A/D converter 62, and is supplied to the PN correlator 66. This PN correlator 66 searches for correlation of the PN signal and the input signal which were assigned to the mobile station with which the mho BAL unit "N" supplied from the PN generator 64 is communicating. That is, by the PN code, out of the signal by which the spread spectrum was carried out, the correlation signal of a specific PN code is taken out and spectrum back-diffusion of gas is performed. A user channel is extracted from the data by which the point-to-multipoint connection was carried out by this. Next, with the Hadamard transform filter 68, Walsh coding is solved and, as for the signal acquired by carrying out back-diffusion of gas, the original data are obtained from maximum. This data is supplied to the user decoder 70. The user decoder 70 performs the maximum **** decode to what was collapsed and encoded by the transmitting side, and obtains user data. Moreover, the user decoder 70 outputs a decode data level per symbol.
[0045] And this decode data level is supplied to closed loop power COP 56, and is used for creating power control command in here.
[0046] Next, the composition of cloth DORUPU power COP 56 is shown in drawing 7 . Thus, a decode data level is supplied to the power averaging-operator machine 80, and calculates a power average here. A power average is performed per slot (1.25msec) by well-known digital processing. And the output from this power averaging-operator machine 80 is measured with reference-electrode level in a comparator 82. Moreover, a decode data level is supplied also to the threshold level detector 84, and the power value below predetermined threshold level is transposed to 0 in here. This is for not incorporating data when transmission is not made for a certain reason, when transmission from a mobile station is burstily performed per slot of 1.25msec(s). And the output of this threshold level detector 84 is supplied to buffer memory 86, and two or more decode data power level of a predetermined period is memorized per symbol in this buffer memory 86. And the history of the power of this buffer memory 86 is supplied to the prediction machine 88, and the prediction machine 88 predicts received power in the predetermined-time point from the history of power. And the value of the received power predicted with this prediction vessel 88 is supplied to a comparator 90, and is compared with reference-electrode level

in here.
[0047] And the signal of the comparison result of a comparator 82 and a comparator 90 is supplied to the power control command generator 94 through AND gate 92. Therefore, according to the comparison result of both of comparators 82 and 90, the power control command generator 94 generates power control command. That is, the power value of the slot unit of the power averaging-operator machine 80 and the forecast of the symbol unit of the prediction machine 88 serve as a signal for the output of both of comparators 82 and 90 making mobile station transmitted power increase, when both are below reference level, both output is set to H, the signal of H is outputted from AND gate 92, and the command of the power control command generator 94 making power increase by this is created. A move machine carries out predetermined level increase of the transmitted power based on this command, and the receiving level in the base music from the mobile station increases.
[0048] Prediction of received power, next the prediction in the prediction machine 88 are explained. For example, as shown in drawing 8 , suppose that received power T changed with time t as shown in drawing. In this case, time t0-tn Each power is P0 -Pn. It becomes.
[0049] On the other hand, since power control command is inserted at random into a sending signal as mentioned above, its time transmitted towards a mobile is not fixed. Then, the prediction machine 88 gets the signal about the timing of power control command insertion from the transmitting modulator 48, and judges the time actually controlled by power control command created from the control delay (time delay after a mobile receives power control command until power control is actually performed) in this and a mobile. namely, the present time -- tn it is -- received power Ptp in time tn+ delta=tp if time until actual control is performed was delta It predicts.
[0050] Next, this prediction is based and explained in the flow chart view of drawing 9 . First, command transmit timing is inputted from the data in the command transmitting modulator 48 (S11). And it decides on time (prediction time tp) for a move machine to control transmitted power by this command from this command transmit timing (S12).
[0051] Next, by the linear prediction, in order to predict power, it asks for a correlation coefficient. (S13) . In this example, it assumes that phasing is the Rayleigh facing and a correlation coefficient gamma (tp-tj) is calculated by calculating the Bessel function about 2pifd (tp-tj).
[0052]
gamma(tp-tj) =J0 [2pif0] (tp-tj)
Here, it is fd. Those with the maximum Doppler frequency, and tj Each time from which the received power of j= 0 - n is obtained is expressed. and a prediction coefficient alpha 1 - alphan determining (S14) -- the square of a prediction error -- the prediction coefficient alpha 1 - alphan from which an average serves as the minimum It asks by solving the following formula (S15).
[0053]
[Equation 1]

[数1]

$$\begin{pmatrix} \gamma_{tp-t0} & \gamma_{tp-t1} & \gamma_{tp-t2} & \cdots & \gamma_{tp-tn-1} \\ \gamma_{tp-t1} & \gamma_{tp-t0} & \gamma_{tp-t1} & \cdots & \gamma_{tp-tn-2} \\ \gamma_{tp-t2} & \gamma_{tp-t1} & \gamma_{tp-t0} & \cdots & \gamma_{tp-tn-3} \\ \gamma_{tp-t3} & \gamma_{tp-t2} & \gamma_{tp-t1} & \cdots & \gamma_{tp-tn-4} \\ \vdots & \vdots & \vdots & \cdots & \vdots \\ \vdots & \vdots & \vdots & \cdots & \vdots \\ \vdots & \vdots & \vdots & \cdots & \vdots \\ \gamma_{tp-tn-1} & \gamma_{tp-tn-2} & \gamma_{tp-tn-3} & \cdots & \gamma_{tp-t0} \end{pmatrix} \begin{pmatrix} \alpha_1 \\ \alpha_2 \\ \alpha_3 \\ \alpha_4 \\ \vdots \\ \vdots \\ \vdots \\ \alpha_n \end{pmatrix} = \begin{pmatrix} \gamma_1 \\ \gamma_2 \\ \gamma_3 \\ \gamma_4 \\ \vdots \\ \vdots \\ \vdots \\ \gamma_n \end{pmatrix}$$

Here, it is gamma 0. Time tp-t0 A thing and gamma 1 Time tp-t1 Thing -- and gamman-1 Time tp-tn-1 A thing and gamman Time tp-tn A thing is expressed.

[0054] Next, alpha 1 - alphan which were computed It is based and is Ptp=alpha 1 P0+alpha2 P1. alpha3 P2+ -- Ptp is calculated from +alphan Pn-1 (S16). Thus, predetermined time tp The received power Ptp which can be set can be predicted.

[0055] Therefore, the prediction machine 88 in drawing 7 sends this prediction power value to a comparator 90.

[0056] Thus, only when both the power value at that time and the power value by prediction become power increase, the power control command which requires power increase is transmitted because it is larger than the case where the directions of the bad influence at the time of increasing power accidentally decrease in number accidentally. In addition, you may create power control command from the judgment result of only a forecast.

[0057] The modification of this invention is shown in other examples, next drawing 10 . In this example, the digital data receiver 16 and the diversity combiner 18 are added compared with the thing of drawing 1 . Thus, a digital data receiver is formed for attaining path diversity reception two, and it can take out the same signal which reached in another path (path) by performing spectrum back-diffusion of gas about the same PN code to the timing from which both differ. And it connects with the die BASHII combiner 18, and two digital day barrel receivers 14 and 16 take a synchronization for two signals supplied, and the die BASHII combiner 18 adds them. namely, a path -- the difference of the attainment time corresponding to difference is compensated, and it adds with the same phase By this, the signal which reached the mobile with two paths can be added, and the energy of an input signal can be increased. Here, as for this addition, it is good to consider as the weighting addition instead of simple addition which enlarges a wait in the direction of a clearer signal. Increase-ization of suitable signal energy can be attained by this.

[0058] And in this example, the output signal from the die BASHII combiner 18 is inputted into the control processor 32. Then, this control processor 32 can presume phasing speed from change of the received power after weighting addition was carried out. However, it is necessary to transform into the formula in consideration of diversity reception the formula which asks for the maximum Doppler of drawing 4 in this case. Therefore, phasing speed with a more high precision can be presumed, and equalization time in the transmitted power controller 28 can be controlled according to this. In addition, in this example, a setup of the gain in the transmitted power controller 28 by the control processor 32 is also computed from two of the AGC gain supplied by the energy and the analog receiver 12 of the signal

supplied from the path diversity combiner 18.
[0059] Drawing 11 is an example which performs path diversity reception to a base station side. Therefore, the digital data receiver 93 and the diversity combiner 94 are added. And while the recovery of the data based on path diversity reception is performed, in closed loop power COP 56, the received power in consideration of phasing of the future is predicted from the correlation signal after weighting addition was performed.
[0060] In addition, in an above-mentioned example, although the maximum Doppler frequency was used as a phasing speed, if phasing speed can be presumed, it is applicable to other phasing. Furthermore, what is necessary is just to use the function according to it in presumption of power, if it is other phasing, although the RESSERU function determined the correlation coefficient on the assumption that Rayleigh phasing. You may give other functions on a table etc. That is, the formula which asks for a correlation coefficient can be determined by asking for a power spectrum and carrying out the Fourier transformation of this. Furthermore, even if prediction is not a linear prediction, other prediction methods may be used for it.
[0061]
[Effect of the Invention] Since received power is detected using a pilot signal according to this invention as explained above, to the input-signal power of only the base station of a local station, transmitted power can be controlled and suitable power control can be performed. Moreover, phasing speed is presumed, since it decides on time for input-signal power to average according to this phasing speed, it can average in always suitable time and the electric-field median of phasing can be presumed. For this reason, transmitted power can be increased, without there being few errors and causing increase of interference of a system in control of an open loop. Moreover, degradation of the transmission characteristic of a local station can be prevented, without increasing interference of a system.
[0062] Furthermore, in a base station side, since the situation of the future of the electric wave from the mobile which receives in a base station is predicted and power control command is transmitted, let control of the received power by the side of a base station be an exact thing by controlling transmitted power according to this power control command. And such a result, transmitted power control becomes exact and the improvement in a transmission characteristic and increase of circuit capacity are attained.

[Translation done.]

* NOTICES *

OPERATION

[Function] Thus, according to this invention, since received power is detected using a pilot signal, to the input-signal power of only the base station of a local station, transmitted power can be controlled and suitable power control can be performed. Moreover, phasing speed is presumed, since it decides on time for input-signal power to average according to this phasing speed, it can average in always suitable time and the electric-field median of phasing can be presumed. For this reason, an open loop is appropriately controllable, and transmitted power can be increased, without causing increase of interference of a system. Moreover, degradation of the transmission characteristic of a local station can be prevented, without increasing interference of a system.
[0024] Furthermore, in a base station side, since the situation of the future of the electric wave from the mobile which receives in a base station is predicted and power control command is transmitted, let control of the received power by the side of a base station be an exact thing by controlling transmitted power according to this power control command. And such a result, transmitted power control becomes exact and the improvement in a transmission characteristic and increase of circuit capacity are attained.

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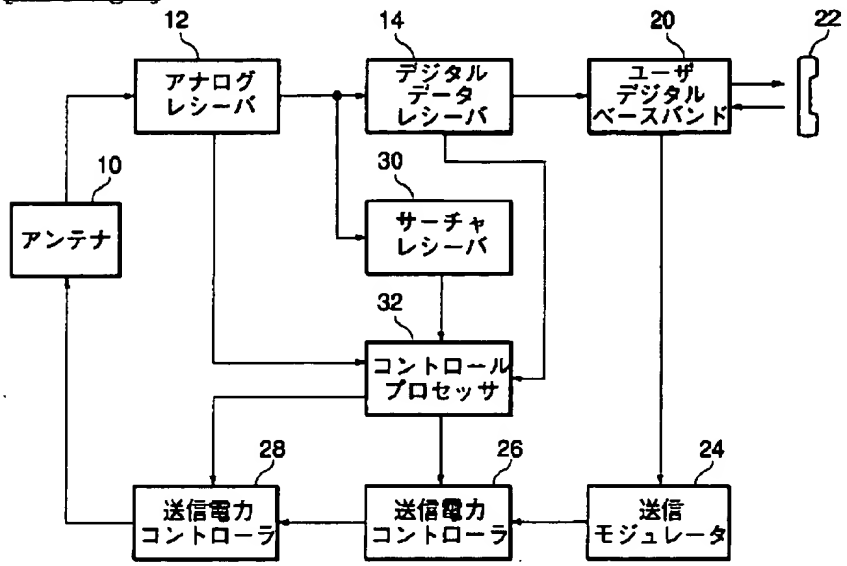
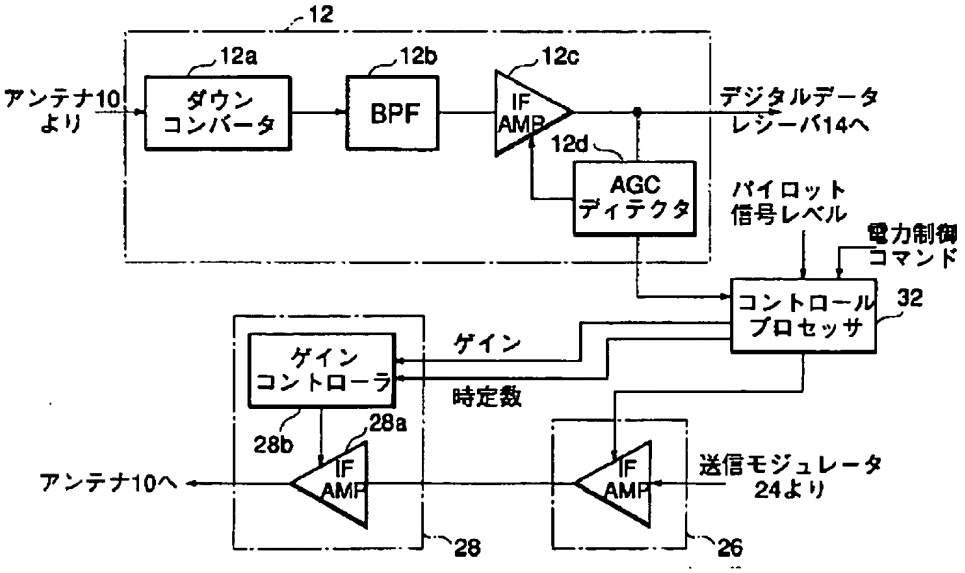
DRAWINGS

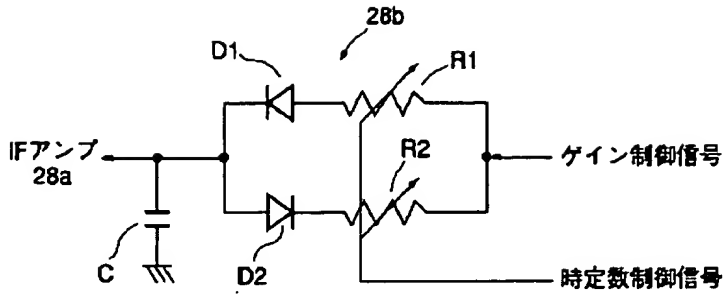
[Drawing 1]



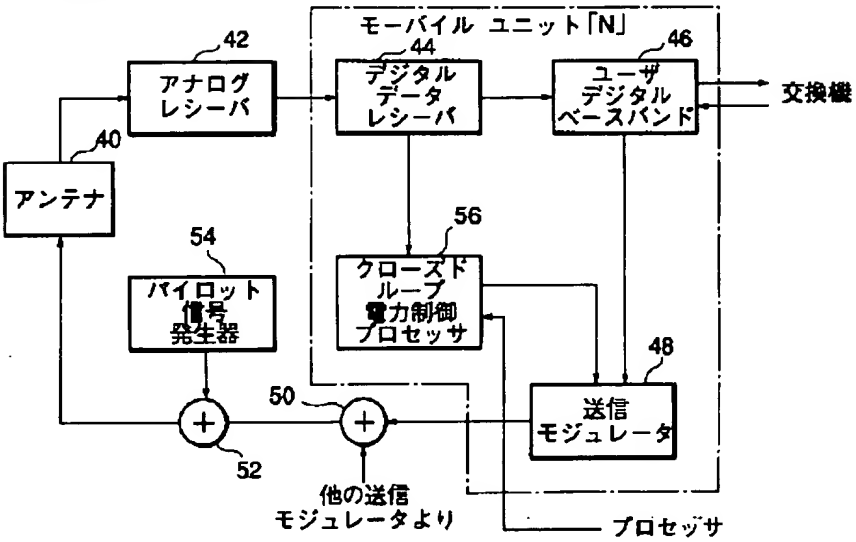
[Drawing 2]



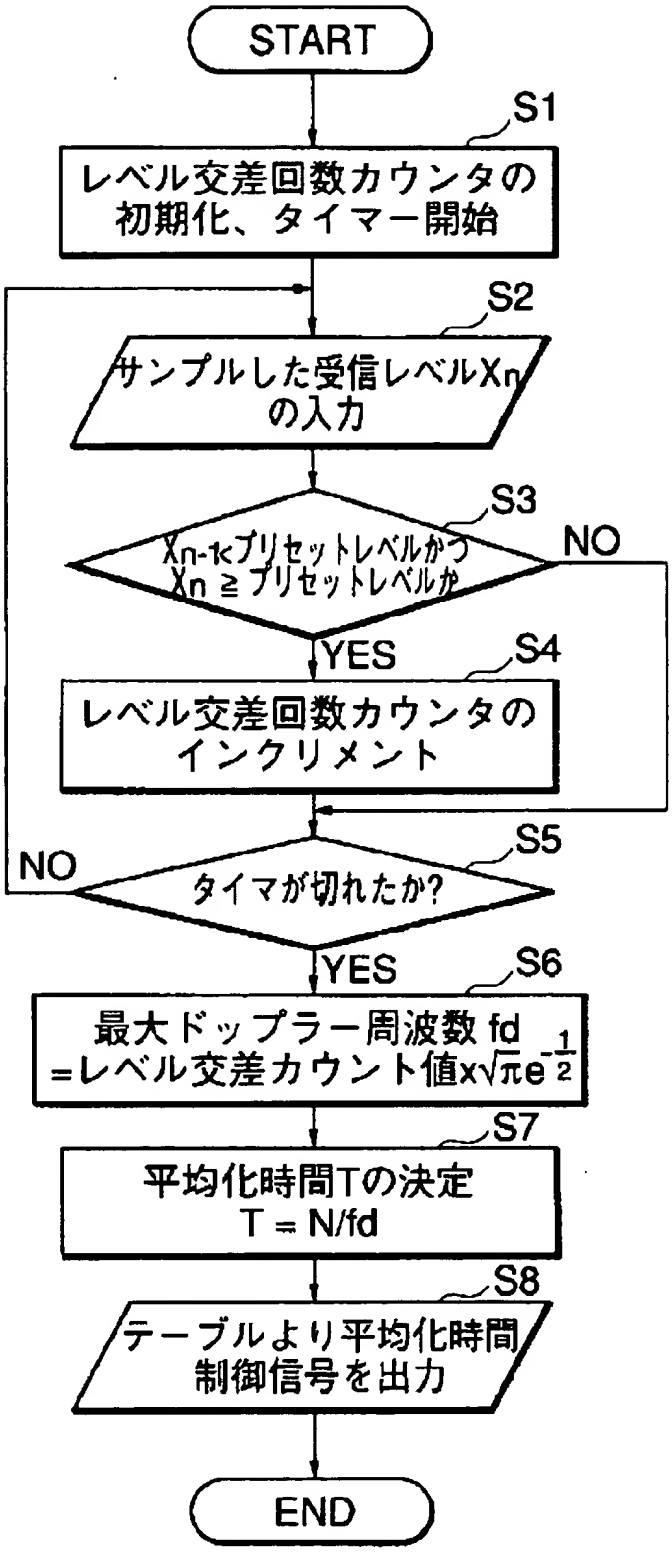
[Drawing 3]



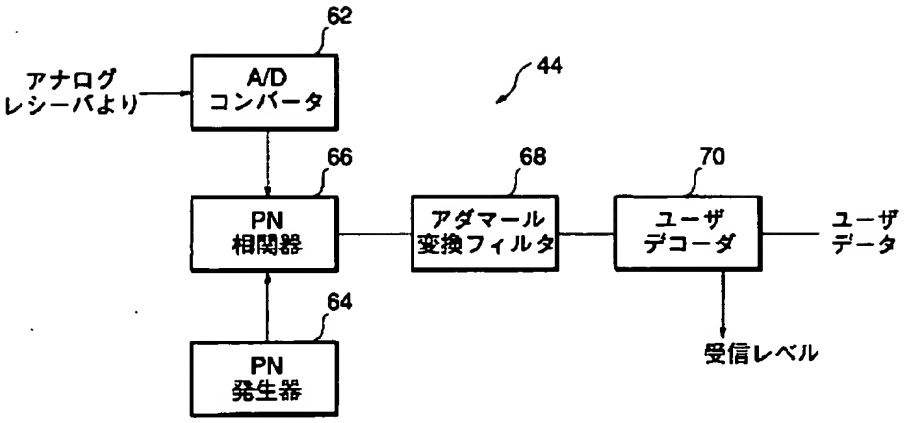
[Drawing 5]



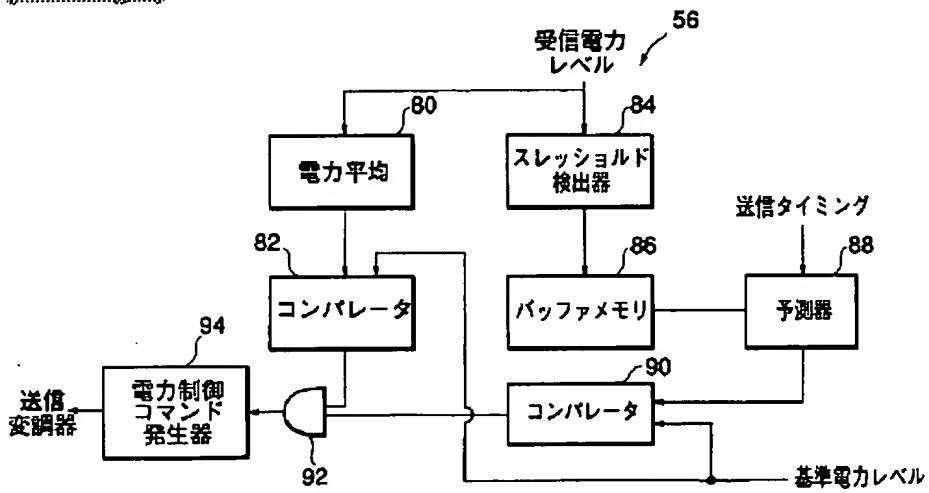
[Drawing 4]


START
S1
レベル交差回数カウンタの
初期化、タイマー開始
S2
サンプルした受信レベルXn
の入力
S3
Xn-kプリセットレベルかつ
Xn ≧ プリセットレベルか
NO
YES
S4
レベル交差回数カウンタの
インクリメント
S5
NO
タイマが切れたか?
YES
S6
最大ドップラー周波数 fd
=レベル交差カウント値x√πe^-1/2
S7
平均化時間Tの決定
T = N/fd
S8
テーブルより平均化時間
制御信号を出力
END

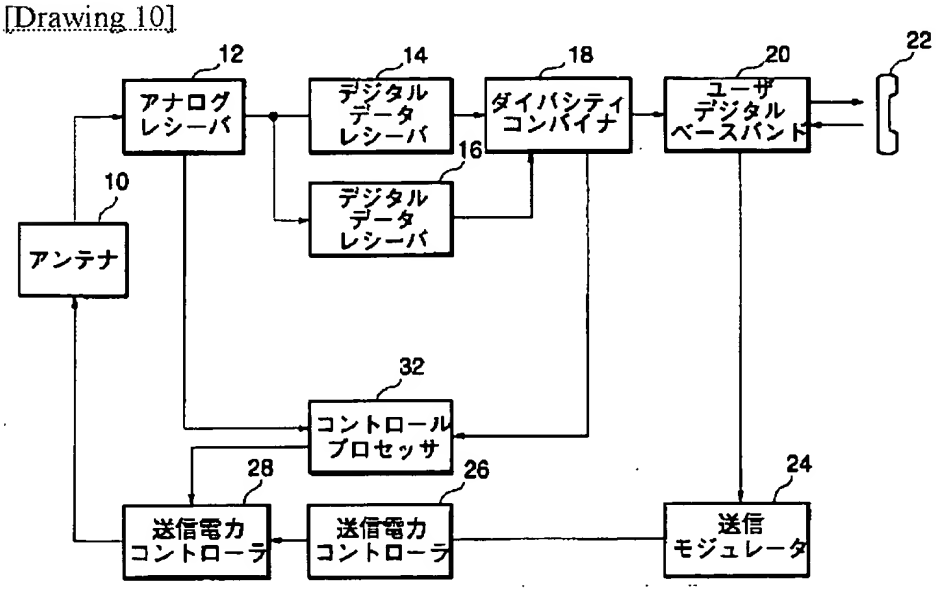
[Drawing 6]



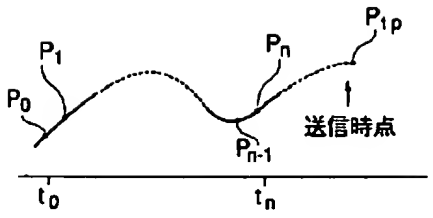
[Drawing 7]



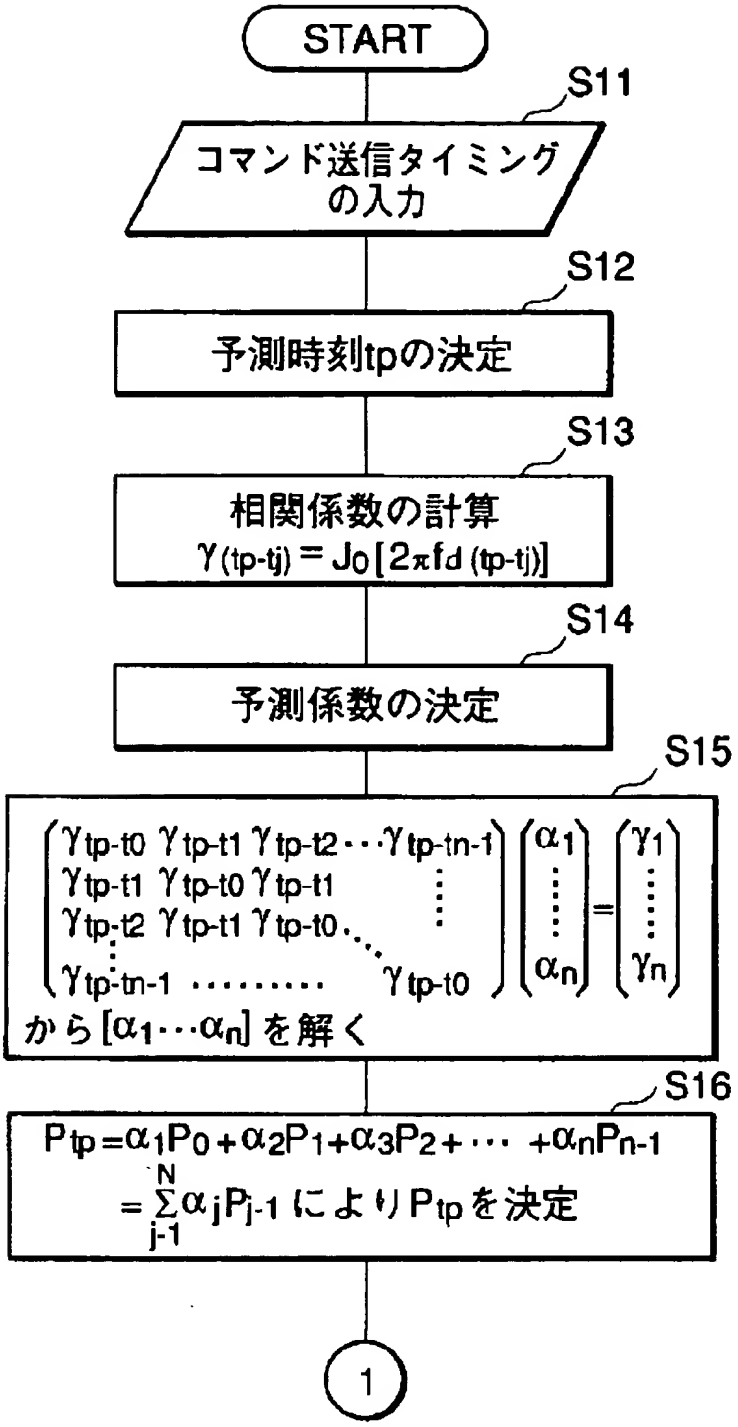
[Drawing 10]



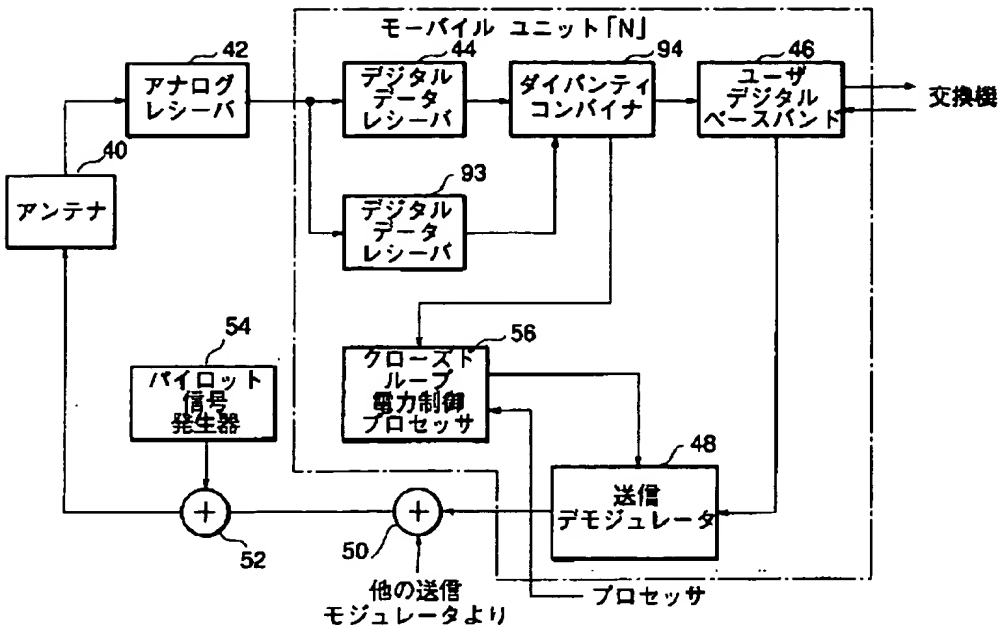
[Drawing 8]



[Drawing 9]


START
S11
コマンド送信タイミング
の入力
S12
予測時刻tpの決定
S13
相関係数の計算
γ(tp-tj) = J0[2πfd(tp-tj)]
S14
予測係数の決定
S15
から[α1…αn]を解く
S16
Ptp=α1P0+α2P1+α3P2+… +αnPn-1
=Σ(j-1 to N) αjPj-1 によりPtpを決定
1

[Drawing 11]



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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is the block diagram showing the whole move machine side composition.
[Drawing 2] It is a block diagram about the member in connection with power control of this example.
[Drawing 3] It is the circuit diagram showing the mechanism of the gain control in the transmitted power controller 28.
[Drawing 4] It is a flow chart explaining operation of phasing speed presumption.
[Drawing 5] It is the block diagram showing the whole base station side composition.
[Drawing 6] It is the block diagram showing the detail of the digital data receiver 44 of this example.
[Drawing 7] It is the block diagram showing the detail of closed power COP 56.
[Drawing 8] It is explanatory drawing showing prediction of received power.
[Drawing 9] It is the flow chart which shows operation of prediction of received power.
[Drawing 10] It is the block diagram showing the composition of other examples by the side of a move machine.
[Drawing 11] It is the block diagram showing the composition of other examples by the side of a base station.
[Description of Notations]
12 42 Analog receiver
14 44 Digital data receiver
20 46 User digital baseband circuit
24 48 Transmitting modulator
26 28 Transmitted power controller
30 Searcher Receiver
32 Control Processor
56 Closed Power COP

[Translation done.]

* NOTICES *

CORRECTION or AMENDMENT

[Official Gazette Type] Printing of amendment by the convention of 2 of Article 17 of patent law
[Section partition] The 3rd partition of the 7th section
[Date of issue] March 28, Heisei 9 (1997)

[Publication No.] Publication number 6-13956
[Date of Publication] January 21, Heisei 6 (1994)
[**** format] Open patent official report 6-140
[Filing Number] Japanese Patent Application No. 4-171363
[International Patent Classification (6th Edition)]

H04B 7/26 102
17/00

[FI]

H04B 7/26 102 7605-5J
17/00 G 7739-5J

[Procedure revision]
[Filing Date] May 16, Heisei 8
[Procedure amendment 1]
[Document to be Amended] Specification
[Item(s) to be Amended] 0026
[Method of Amendment] Change
[Proposed Amendment]
[0026] Composition by the side of a move machine
Drawing 1 is the block diagram showing the whole move machine composition to which the transmission-control equipment concerning this invention is applied. In drawing, an antenna 10 receives or emits the electric wave containing the frequency used for communication at least. The analog receiver 12 is connected to this antenna 10, and the analog receiver 12 chooses only the signal band of predetermined frequency while he changes a received electric wave into an intermediate frequency (down conversion) and gets an IF signal. Moreover, it controls by the AGC means to become fixed about the signal level of the IF signal to output. The digital data receiver 14 is connected to the analog receiver 12, and the digital data receiver 14 processes conversion to the digital data of an analog signal, a synchronous detection, spectrum back-diffusion of gas, etc. The user digital baseband circuit 20 is connected to the digital data receiver 14, and the user digital baseband circuit 20 performs a data recovery etc., and obtains an audio signal through the interface of a vocoder etc. And this audio signal is supplied to a hand set 22, and reproduction of an audio signal is performed. That is, the voice which received from the loudspeaker of a hand set 22 is outputted.

[Procedure amendment 2]
[Document to be Amended] Specification
[Item(s) to be Amended] 0028
[Method of Amendment] Change
[Proposed Amendment]
[0028] Use of a pilot signal
Moreover, the searcher receiver 30 is connected to the analog receiver 12, the pilot signal contained in an input signal here is extracted, and this signal strength is detected. Although it is a signal for using for initial prehension of the base station in a move machine etc. and the same PN code is used in each base station, since this pilot signal has given the sign of a different shift amount, it becomes discriminable based on this. Moreover, this pilot signal is multiplexed by communication data etc. by the Walsh function, and W0 (Walsh function of No.0) is usually assigned. All WO(s) consist of 0 and what hung this in two's complement (+1 is made for 0 to correspond to -) becomes the same as the original signal. Therefore, pilot-signal level can be known only by correlation operation of a PN code. Measurement of pilot level here is performed using path diversity. This is technology which separates frequency-selective phasing which often originates in multiplex transmission delay with the resolution of a diffusion sign, performs bigger weighting to a thing with the separated large level, and doubles and compounds time in mobile communications. By using this path diversity, measurement of pilot level with a high precision can be performed. And the searcher receiver 30 compares the signal level of the pilot signal from two or more base stations, and generates the signal for change of a base station etc.
[Procedure amendment 3]
[Document to be Amended] Specification
[Item(s) to be Amended] 0030
[Method of Amendment] Change
[Proposed Amendment]
[0030] And the control processor 32 knows the AGC gain from the analog receiver 12, and the level of the pilot signal which received from both level of the pilot signal from the searcher receiver 30. And the control processor 32 generates the level control signal of an analog from the obtained receiving intensity, and controls the power of the output signal in the transmitted power controller 28 by this. Moreover, the control processor 32 incorporates the content about the transmitted power control sent from a base station side from the power control command supplied by the digital data receiver 14, and controls the transmitted power controller 26 according to this. Thus, the control processor 32 can perform transmitted power control of an open loop and a closed loop.
[Procedure amendment 4]
[Document to be Amended] Specification
[Item(s) to be Amended] 0043
[Method of Amendment] Change
[Proposed Amendment]
[0043] Moreover, the signal from the exchange is supplied to the transmitting modulator 48 from the user digital baseband circuit 46, and processing of a modulation, a spread spectrum, etc. is performed here. The sending signal outputted from the transmitting modulator 48 is multiplexed with the signal from other transmitting modulators in an adder 50, and in an adder 52, the pilot signal from the pilot-signal generator 54 is supplied to the after [a multiplex] antenna 40, and it is transmitted here. And closed loop power COP 56 is formed in the base station side, from the input-signal level about the move machine supplied by the digital data receiver 44, the transmitted power which should be used in case the mobile station transmits is calculated, and power control command is created. And closed loop power COP 56 supplies this power control command to the transmitting modulator 48, and the transmitting modulator 48 inserts power control command into a sending signal.
[Procedure amendment 5]
[Document to be Amended] Specification
[Item(s) to be Amended] 0049

[Method of Amendment] Change
[Proposed Amendment]
[0049] On the other hand, since power control command is inserted at random into a sending signal as mentioned above, its time transmitted towards a move machine is not fixed. Then, the prediction machine 88 receives the timing information on power control command insertion from the transmitting modulator 48, and judges the time actually controlled by power control command created from the control delay (time delay after a move machine receives power control command until power control is actually performed) in this and a move machine. namely, the present time -- tn it is -- time until actual control is performed was delta -- then, time tn+ delta=tp Received power Ptp which can be set It predicts.

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CLAIMS

[Claim(s)]
[Claim 1] The transmitted power control unit in the mobile communications characterized by having the searcher receiver which detects the signal level of the extracted pilot signal, and the transmitted power control means which controls transmitted power according to the signal level from this searcher receiver while extracting the pilot signal for every base station out of an input signal.
[Claim 2] A level detection means to detect the signal level of an input signal, and an equalization means to carry out average processing of the signal level of the detected input signal by predetermined averaging time, and to obtain an average received signal level, The transmitted power control means which controls transmitted power according to the obtained average signal level, The transmitted power control unit in the mobile communications characterized by having a phasing speed detection means to detect a phasing rate from change of the signal level of an input signal, and the averaging time control means which changes the above-mentioned averaging time according to the obtained phasing rate.
[Claim 3] The transmitted power control unit in the mobile communications characterized by to have a level detection means detect the signal level of an input signal, a hysteresis storage means memorize the hysteresis of the signal level of the obtained input signal, a prediction means predict the signal level of the input signal after predetermined time from the hysteresis memorized, a creation means create the power control command about the transmitted power control in a signal transmitting side according to the signal level predicted, and a transmitting means transmit the created power control command.
[Claim 4] It is a transmitted power control unit in the mobile communications characterized by predicting by linear prediction from the contents of the hysteresis the above-mentioned prediction means is remembered to be in equipment according to claim 3.
[Claim 5] It is a transmitted power control unit in the mobile communications characterized by detecting based on the count to which the above-mentioned phasing speed detection means investigates the change condition of a received signal level in equipment according to claim 2, and a received signal level intersects constant value in predetermined time.
[Claim 6] With the searcher receiver which detects the signal level of the extracted pilot signal while extracting a pilot signal out of an input signal An equalization means to carry out average processing of the signal level from this searcher receiver by predetermined averaging time, and to obtain average signal level, The transmitted power control means which controls transmitted power according to the obtained average signal level, The transmitted power control unit in the mobile communications characterized by having a phasing speed detection means to detect a phasing rate from change of the signal level from a searcher receiver, and the averaging time control means which changes the above-mentioned averaging time according to the obtained phasing rate.
[Claim 7] It is the transmitted power control system which controls the transmitted power by the side of the mobile in the mobile communications between a base station and a mobile. A base station side A signal level detection means to detect the received signal level of the electric wave sent from a mobile, A hysteresis storage means to memorize the hysteresis of the signal level of the obtained input signal, and a prediction means to predict the signal level of the input signal after predetermined time from the

hysteresis memorized, A creation means to create the power control command about the transmitted power control in a signal transmitting side according to the signal level predicted, It has a transmitting means to transmit the created power control command. A mobile side With the searcher receiver which detects the signal level of the extracted pilot signal while extracting a pilot signal out of an input signal While determining transmitted power as an equalization means to carry out average processing of the signal level from this searcher receiver by predetermined averaging time, and to obtain average signal level, according to average signal level The transmitted power control system in the mobile communications characterized by having the transmitted power control means which changes the determined transmitted power according to a power transmitting command.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] This invention relates to the transmitted power control in the mobile communications by the CDMA (code division multiple access) method.
[0002]
[Description of the Prior Art] Mobile communications, such as a land mobile radiotelephone and a cellular phone, are spreading widely with the advance of electronic communication technology in recent years. And also in the field of these mobile communications, digital communication is examined and various kinds of communication modes are examined. There is a CDMA (code division multiple access) method as one of such the methods, and since it has the descriptions, like that two or more mobiles can be assigned and a nondisclosure is easy in the same frequency range, attention is attracted.
[0003] A diffusion means by which a PN code etc. performs a spread spectrum other than the transmitter which performs the usual electric-wave communication link, a receiver, and a modem is required, and the back-diffusion-of-electrons means for carrying out the back diffusion of electrons of the PN code is required of this CDMA method (especially direct diffuse-spectrum diffusion : CDMA method using DS/SS).
[0004] And it is necessary to take out the signal by which the spread spectrum is carried out and to get over by the specific sign by the CDMA method, out of two or more diffusion signals in the same frequency band. In a CDMA system, by transmission (forward link) to a mobile from a base station, the pseudo-random sign which has a different phase shift for every base station is made into the diffusion sign, and each channel is multiplexed by the orthogonal function (a cross-correlation is the function of 0), and is transmitted so that a mobile can identify a base station. The pilot signal is also included in it and a mobile uses this pilot signal for initial prehension and a synchronization.
[0005] Moreover, in transmission (reverse link) to a base station from a mobile, what formed successively a pseudo-random sign without offset and the pseudo-random signs specified for every user is made into the diffusion sign. Since each mobile has a various distance with a base station, it is difficult to take the synchronization of the sending signals of all mobiles in a base station, and it is impossible to maintain the orthogonality between each mobile. Since a diffusion sign also takes such a point into consideration and it is determined, if the location which only overlap only shifted, a mutual intervention is small enough. However, when a big difference is in received power from the mobile not only in such interference but a base station, interference with the big power of the mobile which was big received power for the mobile which was small received power will be given. Also in such a situation, it has the transmitted power control means for making it the reinforcement of the received power from each mobile become fixed.
[0006] Here, there are the same thing and a thing which is different in a mobile [resulting from Rayleigh fading etc.] and base station side in change of the received power in mobile communications by the mobile [, such as a loss (shadowing) accompanying electric-wave shelters, such as a building which exists in the loss (pass loss) based on distance and propagation path of a radio-wave-propagation

path,], and base station side.
[0007] About what produces the same change on the strength in a mobile and base station side, the received radio field intensity in a base station is brought close to constant value by measuring the received-power reinforcement of the transmitted electric wave from a base station in a mobile, averaging this by time amount to the extent that the effect of Rayleigh fading is removable, detecting an equalization median, and controlling transmitted radio field intensity based on this (this is called open loop control). Specifically, it is the AGC circuit (in order to avoid the input of the excessive signal to the latter part) of the IF signal (intermediate frequency signal which carried out the down convert of the received radio frequency signal (RF signal)) in the input stage of a receiver. Received power is detected from the signal about the gain of the circuit which controls the gain of amplifier according to input signal reinforcement, and the signal strength of the signal frequency band after band pass filter (filter which passes only desired frequency band) passage, and transmitted power is controlled according to this.
[0008] In order that received power may increase rapidly like [when a mobile slips out of the shadow of a building] on the other hand and big effect may appear in other communication links in this case, transmitted power must be decreased promptly. Then, the averaging time for calculating an above-mentioned median from increase of received power is set up short that it should be coped with in such a case. That is, to reduction (increase of received power) of transmitted power, it is short in averaging time, averaging time is set up for a long time to increase (reduction in received power) of transmitted power, and open-loop transmitted power control is performed.
[0009] On the other hand, about that from which field strength differs by the mobile [, such as Rayleigh fading,] and base station side, it cannot respond by open loop control. Then, in order to cope with this, in a base station, the received field strength from each mobile station is detected, and the command (power control command) for amending transmitted power to a mobile station side is sent to a mobile station based on this received field strength. And the mobile is considering as the thing of a request of the received field strength in a base station by controlling transmitted power based on this power control command (this is called closed loop control). Power control command orders it whether to raise power or to lower, and is transmitted once to 1.25msec. Moreover, control of about **1dB is performed around open-loop power control by one control.
[0010] By performing such transmitted power control, these interference can be decreased considering the reinforcement of the input signal from each mobile in a base station as an equivalent thing. Then, the communication link with more mobiles is attained and the capacity of a system can be maximized.
[0011] In addition, the transceiver facility and the conventional transmitted power control by the side of the mobile of a CDMA method and a base station (cel site) are shown, for example in the U.S. Pat. No. 5,103,459 number official report, the international public presentation official report WO 91/No. 07037 official report, etc.
[0012]
[Problem(s) to be Solved by the Invention] However, if it was in the conventional transmitted power control, there were the following troubles.
(A) The sending signal from other base stations is also contained in received power, and the sending-signal reinforcement from other base stations is large especially in the boundary neighborhood of the jurisdiction range of a base station (cel). Then, the transmitted power control to the target base station will become unsuitable. In addition, theoretically, since the electric energy changed by 1 time of the command by power control command as mentioned above although this should be able to be canceled by closed loop control is limited, it may cross an amendment limitation.
[0013] (B) Since Rayleigh fading changes with rates of a mobile, depending on the rate of phasing, between mean times is too short and open-loop transmitted power control may follow Rayleigh fading. When between mean times is lengthened too much, it becomes impossible in addition, to follow change of a phasing median.
[0014] (C) Although power control command is inserted into the usual commo data in a forward link and it is sent once to 1.25msec(s) on the average, the insertion point (timing to send) is randomized.

Moreover, in the reverse link, in the silent period, a mobile performs bursty transmission rather than transmits continuously, and this transmit timing is also randomized. For example, in the frame of 20msec, although 16 slots of 1.25msec units exist, in the case of a full rate, all 16 slots are transmitted, and, in the case of 1/2 rate, it transmits a slot to eight of 16 places. And the phase of the slot is randomized. In addition, there are a full rate, 1/2 rate, 1/4 rate, and 1/8 rate as transmission rate. For this reason, a base station recognizes the received power from a mobile, and time amount until power control command is received by the mobile is changed. Then, it is not fixed, the timing of control shifts and the time amount to which transmitted power control according to power control command is carried out may be unable to perform exact transmitted power control. Especially, this problem becomes large when a phasing rate is early.

[0015] This invention is made in view of the above-mentioned technical problem, and aims at offering the transmitted power control unit in the mobile communications which are adapted for the situation of a mobile and can perform suitable transmitted power control, and its system.

[0016]

[Means for Solving the Problem] The transmitted power control unit in the mobile communications concerning this invention is characterized by having the searcher receiver which detects the signal level of the extracted pilot signal, and the transmitted power control means which controls transmitted power according to the signal level from this searcher receiver while it extracts the pilot signal for every base station out of an input signal.

[0017] Moreover, it carries out having a level detection means detect the signal level of an input signal, an equalization means carry out average processing of the signal level of the detected input signal by predetermined averaging time, and obtain an average received signal level, the transmitted power control means that control transmitted power according to the obtained average signal level, a phasing speed-detection means detect a phasing rate from change of the signal level of an input signal, and the averaging-time control means which change the above-mentioned averaging time according to the obtained phasing rate as the description.

[0018] Moreover, it is characterized by to have a level detection means detect the signal level of an input signal, a hysteresis storage means memorize the hysteresis of the signal level of the obtained input signal, a prediction means predict the signal level of the input signal after predetermined time from the hysteresis memorized, a creation means create the power control command about the transmitted power control in a signal transmitting side according to the signal level predicted, and a transmitting means transmit the created power control command.

[0019] Moreover, the above-mentioned prediction means is characterized by predicting by linear prediction from the contents of the hysteresis memorized.

[0020] Moreover, the above-mentioned phasing speed detection means investigates the change condition of a received signal level, and is characterized by detecting based on the count to which a received signal level intersects constant value in predetermined time.

[0021] With moreover, the searcher receiver which detects the signal level of the extracted pilot signal while extracting a pilot signal out of an input signal An equalization means to carry out average processing of the signal level from this searcher receiver by predetermined averaging time, and to obtain average signal level, The transmitted power control means which controls transmitted power according to the obtained average signal level, It is characterized by having a phasing speed detection means to detect a phasing rate from change of the signal level from a searcher receiver, and the averaging time control means which changes the above-mentioned averaging time according to the obtained phasing rate.

[0022] This invention is a transmitted power control system which controls the transmitted power by the side of the mobile in the mobile communications between a base station and a mobile. Moreover, a base station side A signal level detection means to detect the received signal level of the electric wave sent from a mobile, A hysteresis storage means to memorize the hysteresis of the signal level of the obtained input signal, and a prediction means to predict the signal level of the input signal after predetermined time from the hysteresis memorized, A creation means to create the power control command about the

transmitted power control in a signal transmitting side according to the signal level predicted, It has a transmitting means to transmit the created power control command. A mobile side With the searcher receiver which detects the signal level of the extracted pilot signal while extracting a pilot signal out of an input signal While determining transmitted power as an equalization means to carry out average processing of the signal level from this searcher receiver by predetermined averaging time, and to obtain average signal level, according to average signal level It is characterized by having the transmitted power control means which changes the determined transmitted power according to a power transmitting command.

[0023]

[Function] Thus, according to this invention, since received power is detected using a pilot signal, to the received signal power of only the base station of a local station, transmitted power can be controlled and suitable power control can be performed. Moreover, a phasing rate is presumed, since it decides on the time amount which received signal power averages according to this phasing rate, it can average by always suitable time amount, and the electric-field median of phasing can be presumed. For this reason, open-loop is appropriately controllable, and transmitted power can be increased, without causing increase of interference of a system. Moreover, degradation of the transmission characteristic of a local station can be prevented, without increasing interference of a system.

[0024] Furthermore, in a base station side, since the situation of the future of the electric wave from the mobile received in a base station is predicted and power control command is transmitted, control of the received power by the side of a base station can be made exact by controlling transmitted power according to this power control command. And such a result, transmitted power control becomes exact and increase of circuit capacity is attained by the improvement list of a transmission characteristic.

[0025]

[Example] Hereafter, the example of this invention is explained based on a drawing.

[0026] The block diagram 1 by the side of a mobile is a block diagram showing the whole migration machine configuration to which the transmission-control equipment concerning this invention is applied. In drawing, an antenna 10 receives the electric wave containing the frequency used for the communication link at least. The analog receiver 12 is connected to this antenna 10, and while the analog receiver 12 changes a received electric wave into an intermediate frequency (down convert) and obtaining an IF signal, only a band chooses the signal of predetermined frequency. Moreover, it controls by the AGC means to become fixed about the signal level of the IF signal to output. The digital data receiver 14 is connected to the analog receiver 12, and the digital data receiver 14 processes conversion to the digital data of an analog signal, a synchronous detection, the spectrum back diffusion of electrons, etc. The user digital baseband circuit 20 is connected to the digital data receiver 14, and the user digital baseband circuit 20 performs a data recovery etc., and obtains an audio signal through the interface of a sound signal etc. And this audio signal is supplied to a hand set 22, and playback of an audio signal is performed. That is, the voice which received from the loudspeaker of a hand set 22 is outputted.

[0027] On the other hand, as for the hand set 22, the microphone is also formed, and a sound signal is supplied to the user digital baseband circuit 20 as an audio signal. In the user digital baseband circuit 20, the interface of voice coding etc. is connected to through and the transmitting modulator 24, and processing of A/D conversion, modulations (for example, QPSK modulation etc.), a spread spectrum (for example, direct diffusion by the PN code), etc. is performed here. And series connection of the transmitted power controllers 26 and 28 is carried out to the transmitting modulator 24, magnification processing of here predetermined gain is performed to it, and it is transmitted to it from an antenna 10 (after a rise convert is carried out, usually transmitted).

[0028] The searcher receiver 30 is connected to use and the analog receiver 12 of a pilot signal, the pilot signal included in an input signal here is extracted, and this signal strength is detected. Although it is a signal for using for initial prehension of the base station in a mobile station etc. and the same sign is used in each base station, since this pilot signal has given the sign of a different shift amount, it becomes discriminable based on this. Moreover, this pilot signal is multiplexed by commo data etc. by the Walsh function, and W0 (Walsh function of No.0) is usually assigned. Then, with the Hadamard filter, a pilot

signal can be extracted and this signal level can be known. Measurement of pilot level here is performed using pass diversity. This is a technique which separates frequency selective phasing which often originates in multiplex transmission delay with the resolving power of a diffusion sign, performs bigger weighting to a thing with the separated large level, and doubles and compounds time amount in mobile communications. By using this pass die HASHICHI, measurement of pilot level with a high precision can be performed. And the searcher receiver 30 compares the signal level of the pilot signal from two or more base stations, and generates the signal for modification of a base station etc.

[0029] In this example, the control processor 32 is connected to the searcher receiver 30, and the signal about the level of a pilot signal is supplied here. Moreover, the signal about the gain of AGC from the analog receiver 12 and the signal about the power control command from the digital data receiver 14 are also supplied to this control processor 32.

[0030] And the control processor 32 gets to know the AGC gain from the analog receiver 12, and the level of the pilot signal received from both level of the pilot signal from the searcher receiver 30. And the control processor 32 generates the level control signal of an analog from the obtained receiving reinforcement, and controls the power of the output signal in the transmitted power controller 28 by this. Moreover, the control processor 32 gets to know the contents about the transmitted power control sent from a base station side from the power control command supplied by the digital data receiver 14, and controls the transmitted power controller 26 according to this. Thus, the control processor 32 can perform transmitted power control of open-loop and a closed loop.

[0031] The member for transmitted power control is shown in the block diagram 2 for transmitted power control. Thus, the analog receiver 12 consists of down converter 12a, band pass filter 12b, IF amplifier12c, and AGC detector 12d. Then, the RF signal supplied from an antenna 10 is changed into an IF signal by down KOBATA, and the signal of the frequency band used for the communication link by band pass filter 12b is chosen. The output of band pass filter 12b is made the IF signal of almost fixed level by IF amplifier 12c, and is supplied to the digital data receiver's 14 A/D converter. Moreover, in order to control the output level of an IF amplifier, AGC detector 12d is prepared, and this AGC detector 12d detects the output level of IF amplifier 12c, and is carrying out feedback control of the gain of IF amplifier 12c according to this.

[0032] And the signal about the gain to feed back is supplied to the control processor 32 this AGC detector 12d. Then, the control processor 32 can recognize the level of the pilot signal supplied by the searcher receiver 30, and the level of the pilot signal received from both signals about AGC gain. Especially, the level of this pilot signal is separated and recognized for every base station in the searcher receiver 30 as mentioned above. Then, the received power obtained here can except the signal from other base stations, and can know correctly the received power of the signal from the base station which is communicating. Therefore, even if it is near the boundary of a cel (area the base station whose number is one has jurisdiction [area]) where the level of the signal from that of two or more base stations becomes large, exact detection of the received signal level from the target base station can be performed, and suitable transmitted power control can be performed by supplying the signal of the difference of this detection result and desirable mobile station level to a transmitted power controller.

[0033] Although the control processor 32 controls the transmitted power controller 28 according to the obtained received power, this transmitted power controller 28 consists of IF amplifier 28a and gain controller 28b which controls this gain. And based on the gain control signal supplied from the control processor 32, gain controller 28b controls the gain of IF amplifier 28a.

[0034] Here, in this example, the control processor 32 also supplies a time constant control signal to gain controller 28b besides a gain control signal. And gain controller 28b has variable resistance R1 and R2, diodes D1 and D2, and Capacitor C, as shown in drawing 3 . Moreover, variable resistance R1, the series connection of diode D1, and variable resistance R2 and the series connection of diode D2 are connected to juxtaposition, a gain control signal is inputted into variable-resistance R1R2, and diodes D1 and D2 are connected to the gain control edge of Capacitor C and IF amplifier 28. Then, in case the potential of a gain control signal increases, the potential of the signal which controls the gain of IF amplifier 28 by the time constant which becomes settled with the value of R1 and C rises, and in case

the potential of a gain control signal decreases, the potential of the signal which controls the gain of IF amplifier 28 by the time constant which becomes settled with the value of R2 and C descends. For this reason, the response of the transmitted power to a gain control signal is made to a different thing by making the value of R1 and R2 into a different thing. Time constant R1C of the power increase direction is set up more greatly than time constant R2C of the power reduction direction. For example, it is set up with R1=10R2.

[0035] Furthermore, modification of the resistance of variable resistance R1 and R2 is attained with the time constant control signal, with the above-mentioned relation maintained. Then, the earliness of a response to received power can be changed from that of the command from the control processor 32. And the control processor 32 detects a phasing rate from change of received power, changes the resistance of R1 and R2 according to this, changes the time constant in this circuit, and controls the response of the transmitted power controller 28 to a gain control signal by this example.

[0036] Actuation of detection of a phasing rate, then the phasing detection in the control processor 32 is explained based on drawing 4 .

[0037] First, while initializing the count counter of a level crossover (reset), actuation of the timer which specifies a count period is started (S1). And value xn about the received power inputted It inputs and judges whether they are the last value xn-1 < presetting level and xn >= presetting level (S3). That is, it judges whether there was any level crossover by judging whether it changed from the value of under the presetting level determined beforehand to the above value. And if it is YES, the increment (1 addition) of the value of the count counter of a level crossover will be carried out (S4). On the other hand, this S4 is bypassed when it does not cross in S3. Next, when having not judged and (S5) run out [whether the timer was turned off and] (did you check the value of a timer and did 1 time of a count period pass?), the count of a return level crossover is repeated to S2. In addition, receiving level xn What is necessary is to carry out the 1msec grade equalization of the pilot level, and just to set the period of a timer as 1 second.

[0038] Thus, in order that the count of the level crossover within predetermined time may count, it is the maximum Doppler frequency fd next. It asks (S6). It asks for this maximum Doppler frequency by crossover counted value xpi1/2 e-1/2 of level. This is because it is known that a phasing rate corresponds to the maximum Doppler frequency in many cases, and there is above-mentioned relation to the count of a level crossover and the maximum Doppler frequency in phasing in the mobile it runs at the rate of [considerable] an automobile etc. In addition, this is shown, for example in the Institute of Electronics, Information and Communication Engineers, months [140] 1, Showa 61 issue "the foundation of mobile communication", etc.

[0039] and the called-for maximum Doppler frequency fd from -- the averaging time T suitable for calculating the median of phasing is determined. For example, T=N/fd What is necessary is for the formula to say just to determine. Here, N is a constant and is said for the 36th place to be suitable. Thus, when averaging time T is found, according to this, this is outputted in quest of a time constant control signal from a table (S8).

[0040] That is, the value of the variable resistance R1 and R2 in drawing 3 is changed according to R1=traveler's check, and R2=T/10C, and a gain control signal is averaged with time amount T in the time constant of this circuit. Since a mean time becomes long too much when the passing speed of a mobile is slow, an upper limit is established (for example, 10 seconds). And the gain of IF amplifier 28a is controlled by the gain control signal averaged by the circuit where it did in this way and the time constant was set up.

[0041] Thus, in this example, since it asks for a phasing frequency (the maximum Doppler frequency) and averaging time T is changed according to this, averaging time T can always be made the optimal. then, the thing for which averaging time is too short and open-loop transmitted power control follows phasing -- it can prevent -- moreover -- and when a phasing rate is quick, averaging time can be shortened and it can consider as the early thing of a response of open-loop transmitted power control. In addition, although the maximum Doppler frequency was used as a phasing rate, if the phasing rate is detectable even if it is other phasing, according to this, averaging time is controllable by the above-

mentioned example. Furthermore, although the control processor 32 detected received power from the level of a pilot signal, it can also detect received power with the level of the IF signal outputted by not only this but the analog receiver.

[0042] The configuration by the side of a base station, next the configuration of the communication device by the side of a base station are explained based on drawing 5 . The analog receiver 42 is connected to the antenna 40, this received electric wave is supplied to the analog receiver 42, and an IF signal is outputted. The IF signal from the analog receiver 42 is supplied to the digital data receiver 44 of a mho BAIRU unit "N" (the mho BAIRU unit is prepared corresponding to the number of the mobiles which communicate, and N is a sign which specifies one of them). And the signal which received processing of the back diffusion of electrons outputted by the digital data receiver 44 is supplied to an exchanger through the user digital baseband circuit 46.

[0043] Moreover, the signal from an exchanger is supplied to the transmitting modulator 48 from the user digital baseband circuit 46, and receives processing of a modulation, a spread spectrum, etc. here. The sending signal outputted from the transmitting modulator 48 is supplied to the back antenna 40 with which it multiplexed with the signal from other transmitting modulators in the adder 50, and the pilot signal from a pilot signal generator 54 was multiplexed in the adder 52, and is transmitted here. And the closed loop power control processor 56 is formed in the base station side, from the received signal level about the mobile station supplied by the digital data receiver 44, the transmitted power which should be used in case the mobile station transmits is calculated, and power control command is created. And the closed loop power control processor 56 supplies this power control command to the transmitting modulator 48, and the transmitting modulator 48 inserts power control command into a sending signal.

[0044] Here, the digital data receiver's 44 configuration is shown in drawing 6 . Thus, the Hadamard transform of the correlation signal outputted from A/D converter 62 into which the IF signal from the analog receiver 42 is inputted, the PN generator 64 which generates a predetermined PN code, the PN correlator 66 which performs correlation with the PN code supplied from this PN generator 64, and the PN correlator 66 is carried out, and it has become the Hadamard transform filter 68 which solves Walsh coding from the user decoder 70 which performs the recovery of data. And the IF signal supplied by the analog receiver 42 is changed into digital data by A/D converter 62, and is supplied to the PN correlator 66. This PN correlator 66 searches for correlation of the PN signal and the input signal which were assigned to the mobile station with which the mho BAL unit "N" supplied from the PN generator 64 is communicating. That is, by the PN code, out of the signal by which the spread spectrum was carried out, the correlation signal of a specific PN code is taken out and the spectrum back diffusion of electrons is performed. A user channel is extracted from the data by which the point-to-multipoint connection was carried out by this. Next, with the Hadamard transform filter 68, Walsh coding is solved and, as for the signal acquired by carrying out the back diffusion of electrons, the original data are obtained from maximum. This data is supplied to the user decoder 70. The user decoder 70 performs the maximum **** decode to what was collapsed and encoded by the transmitting side, and obtains user data. Moreover, the user decoder 70 outputs a decode data level per symbol.

[0045] And this decode data level is supplied to the closed loop power control processor 56, and is used for creating power control command in here.

[0046] Next, the configuration of the cloth DORUPU power control processor 56 is shown in drawing 7 . Thus, a decode data level is supplied to the power averaging operator machine 80, and calculates a power average here. A power average is performed per slot (1.25msec) by well-known digital processing. And the output from this power average computing element 80 is measured with reference electrode level in a comparator 82. Moreover, a decode data level is supplied also to the threshold level detector 84, and the power value below predetermined threshold level is transposed to 0 in here. This is for not incorporating data when transmission is not made for a certain reason, also when transmission from a mobile station is burstily performed per slot of 1.25msec(s). And the output of this threshold level detector 84 is supplied to buffer memory 86, and two or more storage of the decode data power level of a predetermined period is carried out per symbol in this buffer memory 86. And the hysteresis of the power of this buffer memory 86 is supplied to the prediction machine 88, and the prediction machine

88 predicts received power in the predetermined time point from the hysteresis of power. And the value of the received power predicted with this prediction vessel 88 is supplied to a comparator 90, and is compared with reference electrode level in here.
[0047] And the signal of the comparison result of a comparator 82 and a comparator 90 is supplied to the power control command generator 94 through AND gate 92. Therefore, according to the comparison result of both of comparators 82 and 90, the power control command generator 94 generates power control command. That is, the power value of the slot unit of the power average computing element 80 and the forecast of the symbol unit of the prediction machine 88 serve as a signal for the output of both of comparators 82 and 90 to make mobile station transmitted power increase, when both are below reference level, both output is set to H, the signal of H is outputted from AND gate 92, and the command of the power control command generator 94 making power increase by this is created. A migration machine carries out predetermined level increase of the transmitted power based on this command, and the receiving level in the base music from that mobile station increases.
[0048] Prediction of received power, next the prediction in the prediction machine 88 are explained. For example, as shown in drawing 8 , received power T presupposes that it changed with time amount t as shown in drawing. In this case, time amount t0-tn Each power is P0 -Pn. It becomes.
[0049] On the other hand, since power control command is inserted at random into a sending signal as mentioned above, its time amount transmitted towards a mobile is not fixed. Then, the prediction machine 88 gets the signal about the timing of power control command insertion from the transmitting modulator 48, and judges the time amount actually controlled by power control command created from the control delay (time delay after a mobile receives power control command until power control is actually performed) in this and a mobile. namely, current time of day -- tn it is -- received power Ptp in time-of-day tn+ delta=tp if time amount until actual control is performed was delta It predicts.
[0050] Next, this prediction is based and explained in the flow chart Fig. of drawing 9 . First, command transmit timing is inputted from the data in the command transmitting modulator 48 (S11). And it decides on the time amount (prediction time amount tp) to which a migration machine controls transmitted power by this command from this command transmit timing (S12).
[0051] Next, by linear prediction, in order to predict power, it asks for a correlation coefficient. (S13) . In this example, it assumes that phasing is the Rayleigh facing and a correlation coefficient gamma (tp-tj) is calculated by calculating the Bessel function about 2pifd (tp-tj).
[0052]
gamma(tp-tj) =J0 [2pif0] (tp-tj)
Here, it is fd. Those with the maximum Doppler frequency, and tj Each time amount from which the received power of j= 0 - n is obtained is expressed. And a prediction coefficient alpha 1 - alphan The prediction coefficient alpha 1 - alphan from which it determines (S14) and the root mean square of a prediction error serves as min It asks by solving a degree type (S15).
[0053]
[Equation 1]

[数1]

$$\begin{pmatrix} \gamma_{tp-t0} & \gamma_{tp-t1} & \gamma_{tp-t2} & \cdots & \gamma_{tp-tn-1} \\ \gamma_{tp-t1} & \gamma_{tp-t0} & \gamma_{tp-t1} & \cdots & \gamma_{tp-tn-2} \\ \gamma_{tp-t2} & \gamma_{tp-t1} & \gamma_{tp-t0} & \cdots & \gamma_{tp-tn-3} \\ \gamma_{tp-t3} & \gamma_{tp-t2} & \gamma_{tp-t1} & \cdots & \gamma_{tp-tn-4} \\ \vdots & \vdots & \vdots & \cdots & \vdots \\ \vdots & \vdots & \vdots & \cdots & \vdots \\ \vdots & \vdots & \vdots & \cdots & \vdots \\ \gamma_{tp-tn-1} & \gamma_{tp-tn-2} & \gamma_{tp-tn-3} & \cdots & \gamma_{tp-t0} \end{pmatrix} \begin{pmatrix} \alpha_1 \\ \alpha_2 \\ \alpha_3 \\ \alpha_4 \\ \vdots \\ \vdots \\ \vdots \\ \alpha_n \end{pmatrix} = \begin{pmatrix} \gamma_1 \\ \gamma_2 \\ \gamma_3 \\ \gamma_4 \\ \vdots \\ \vdots \\ \vdots \\ \gamma_n \end{pmatrix}$$

Here, it is gamma 0. Time-of-day tp-t0 A thing and gamma 1 Time-of-day tp-t1 Thing -- and gamman-1 Time-of-day tp-tn-1 A thing and gamman Time-of-day tp-tn A thing is expressed.

[0054] Next, alpha 1 - alphan which were computed It is based and is Ptp=alpha 1 P0+alpha2 P1. alpha3 P2+ -- Ptp is calculated from +alphan Pn-1 (S16). Thus, predetermined time of day tp The received power Ptp which can be set can be predicted.

[0055] Therefore, the prediction machine 88 in drawing 7 sends this prediction power value to a comparator 90.

[0056] Thus, only when both the power value at that time and the power value by prediction become power increase, the power control command which requires power increase is transmitted because it is larger than the case where the directions of the bad influence at the time of increasing power accidentally decrease in number accidentally. In addition, power control command may be created from the decision result of only a forecast.

[0057] The modification of this invention is shown in other examples, next drawing 10 . In this example, the digital data receiver 16 and the diver city combiner 18 are added compared with the thing of drawing 1 . Thus, a digital data receiver is formed for attaining pass diver city reception two, and it can take out the same signal which reached in another path (pass) by performing the spectrum back diffusion of electrons about the same PN code to the timing from which both differ. And it connects with the diver C combiner 18, and two digital DETARU receivers 14 and 16 take a synchronization for two signals supplied, and the diver C combiner 18 adds them. namely, a path -- the difference of the time of concentration corresponding to difference is compensated, and it adds with the same phase. By this, the signal which reached the mobile with two pass can be added, and the energy of an input signal can be increased. Here, this addition is good to consider as the weighting addition instead of simple addition which enlarges a wait in the direction of a clearer signal. Increase-ization of suitable signal energy can be attained by this.

[0058] And in this example, the output signal from the diver C combiner 18 is inputted into the control processor 32. Then, this control processor 32 can presume a phasing rate from change of the received power after weighting addition was carried out. However, it is necessary to transform into the formula in consideration of diver city reception the formula which asks for the maximum Doppler of drawing 4 in this case. Therefore, a phasing rate with a more high precision can be presumed, and averaging time in the transmitted power controller 28 can be controlled according to this. In addition, in this example, a setup of the gain in the transmitted power controller 28 by the control processor 32 is also computed from two of the AGC gain supplied by the energy and the analog receiver 12 of the signal supplied from

the pass diver city combiner 18.
[0059] Drawing 11 is an example which performs pass diver city reception to a base station side. Therefore, the digital data receiver 93 and the diver city combiner 94 are added. And while the recovery of the data based on pass diver city reception is performed, in the closed loop power control processor 56, the received power of the future in consideration of phasing is predicted from the correlation signal after weighting addition was performed.
[0060] In addition, in an above-mentioned example, although the maximum Doppler frequency was used as a phasing rate, if a phasing rate can be presumed, it is applicable to other phasing. Furthermore, what is necessary is for the RESSERU function to have determined the correlation coefficient on the assumption that Rayleigh fading, but just to use the function according to it in presumption of power, if it is other phasing. Other functions may be given on a table etc. That is, the formula which asks for a correlation coefficient can be determined by asking for a power spectrum and carrying out the Fourier transformation of this. Furthermore, prediction may not be linear prediction or other prediction approaches may be used for it.
[0061]
[Effect of the Invention] Since received power is detected using a pilot signal according to this invention as explained above, to the received signal power of only the base station of a local station, transmitted power can be controlled and suitable power control can be performed. Moreover, a phasing rate is presumed, since it decides on the time amount which received signal power averages according to this phasing rate, it can average by always suitable time amount, and the electric-field median of phasing can be presumed. For this reason, transmitted power can be increased, without there being few errors and causing increase of interference of a system in open-loop control. Moreover, degradation of the transmission characteristic of a local station can be prevented, without increasing interference of a system.
[0062] Furthermore, in a base station side, since the situation of the future of the electric wave from the mobile received in a base station is predicted and power control command is transmitted, control of the received power by the side of a base station can be made exact by controlling transmitted power according to this power control command. And such a result, transmitted power control becomes exact and increase of circuit capacity is attained by the improvement list of a transmission characteristic.

[Translation done.]